

11/26/97
jc380 U.S. PTO

EXPRESS MAIL NO. EM448813693US

PATENT

Attorney Docket No. ZMYJ-05-116

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): Johannes Martin and Michael Busch

For (title): PROCESS AND DEVICE FOR PRODUCING AND UTILIZING GAS FROM
WASTE MATERIALS

TYPE OF APPLICATION

This new application is for a(n)

- ☒ Original (nonprovisional)
☐ Design
☐ Divisional
☐ Continuation
☐ Continuation-in-Part

PAPERS ENCLOSED

- 8 Pages of specification
3 Pages of 18 claims
1 Pages of Abstract
1 Sheet(s) of drawing(s)
[XX] formal
[] informal

DECLARATION OR OATH

☒ Executed by Johannes Martin and Michael Busch

☒ Inventor(s)

☐ Legal Representative of Inventor(s) (37 CFR 1.42 or 1.43)

☐ Joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.

☐ This is the petition required by 37 CFR 1.47 and the statement required by 37 CFR 1.47 is also attached.

☐ Not Executed by _____

ASSIGNMENT

☒ An assignment of the invention to Martin GmbH für Umwelt- und Energietechnik

☒ is attached. A separate ☐ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☒ FORM PTO 1595 is also attached.

☐ will follow.

CERTIFIED COPY**XX** Certified copy(ies) of application(s)

<u>Germany</u>	<u>196 50 119.9</u>	<u>December 3, 1996</u>
(country)	(appln. no.)	(filed)
<hr/>		
(country)	(appln. no.)	(filed)

from which priority is claimed

XX is (are) attached

— will follow

FEE CALCULATION (37 CFR 1.16)

CLAIMS AS FILED			
Number filed	Number	Rate	Basic Fee
	Extra		\$790.00
<hr/>			
Total			
Claims	18 - 20 = 0	x \$ 22.00	\$0
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Independent			
Claims (37 CFR 1.16(b))	1 - 3 = 0	x \$ 82.00	\$0
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Multiple dependent claim(s), if any (37 CFR 1.16(d))		+ \$270.00	\$0
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Filing Fee Calculation			\$ 790.00

— Design Application (\$330.00 - 37 CFR 1.16(f)) \$ _____

— Verified Statement(s) that this is a filing by a small entity under 37 CFR 1.9 and 1.27 is(are) attached.

Filing Fee Calculation (50% of above) \$ _____

FEE PAYMENT BEING MADE AT THIS TIME

— Not Enclosed

— No filing fee is to be paid at this time. (This and the surcharge required by 37 CFR 1.16(e) can be paid subsequently.)

XX Enclosed

[XX] basic filing fee	\$ 790.00
[] fees for claims	\$ _____
[XX] recording assignment (\$40.00 37 CFR 1.21(h))	\$ 40.00
Total fees enclosed	\$ 790.00/\$40.00

METHOD OF PAYMENT OF FEES

XX Check(s) in the amount of \$790.00/\$40.00
— Charge Account No. 23-3000 in the amount of \$_____. A duplicate of this transmittal is attached.

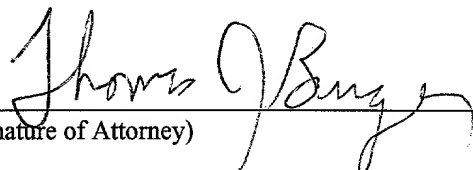
AUTHORIZATION TO CHARGE ADDITIONAL FEES

XX The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 23-3000. A duplicate of this transmittal is attached.
XX 37 CFR 1.16(a), (f) or (g) (filing fees)
XX 37 CFR 1.16(b), (c) or (d) (presentation of extra claims)
XX 37 CFR 1.16(e) (surcharge for filing the basic fee and/or declaration on a date later than the filing date of the application)
XX 37 CFR 1.17 (application processing fees)
— 37 CFR 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 CFR 1.311(b))

INSTRUCTIONS AS TO OVERPAYMENT

[XX] credit Account No. 23-3000
[] refund

WOOD, HERRON & EVANS, L.L.P.


(Signature of Attorney)

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EXPRESS MAIL NO. EM448813693US

In re application of: Johannes Martin and Michael Busch
For: PROCESS AND DEVICE FOR PRODUCING AND UTILIZING GAS
FROM WASTE MATERIALS

Cincinnati, Ohio 45202

Date: November 26, 1997

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

Please amend the application as follows:

In the Specification:

On page 12, delete the word "SUMMARY" at the top and the word "(Figure)" at the bottom, and insert the term --Abstract-- at the top.

In the Claims:

In claim 3, line 1, delete "or 2" .

In claim 4, line 1, delete "one of the claims 1 to 3" and insert --claim 1--.

In claim 5, line 1, delete "one of the claims 1 to 4" and insert --claim 1--.

In claim 6, line 1, delete "one of the claims 1 to 5" and insert --claim 1--.

In claim 7, line 1, delete "one of the claims 1 to 6" and insert --claim 5--.

In claim 9, line 1, delete "one of the claims 1 to 8" and insert --claim 5--.

In claim 10, line 1, delete "claims 5 to 9" and insert --claim 5--.

In claim 11, line 1, delete "one of the claims 5 to 10" and insert --claim 5--.

In claim 12, line 1, delete "one of the claims 1 to 11" and insert --claim 1--.

In claim 14, line 1, delete "12 or".

In claim 15, line 1, delete "one of the claims 12 to 14" and insert --claim 13--.

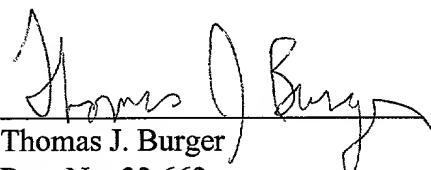
In claim 18, line 1, delete "one of the claims 12 to 17" and insert --claim 13--.

REMARKS

The claims have been amended to eliminate all multiple dependencies. Applicant respectfully requests an examination on the merits of all the pending claims.

Respectfully submitted,

WOOD, HERRON & EVANS, L.L.P.

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Martin GmbH für Umwelt-
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Our code: 001/95/DE

PROCESS AND DEVICE FOR PRODUCING AND
UTILIZING GAS FROM WASTE MATERIALS

The invention pertains to a process and a device for producing and utilizing gas from waste materials, in which the waste materials are transported along a grate in a furnace and combustion air is added.

From patent DE 42 20 265 C1 a process of this type is known in which the waste materials pass sequentially through a drying zone, a carbonizing zone, a reduction zone and an oxidation zone, in order to achieve combustion and coking toward the end of the grate. In this process large proportions of slag are formed, which must be broken up by crushing rollers of correspondingly large dimensions. The energy needed for the gasification process is conveyed to the waste material through convection and radiation by the combustion which occurs at the end of the grate, via the combustion air which is introduced for the most part above the grate. This requires an especially strong combustion process at the end of the grate, with the corresponding formation of coke and slag.

The task of the invention is to achieve a stable gasification process at lower temperatures, and thereby a good burnout of residual material, while avoiding pyrolysis coke in the slag and avoiding formation of large quantities of slag.

This problem is solved in the invention, starting from a process of the type explained at the beginning, by having an arrangement of undergrate forced-draft chambers, at least in the longitudinal direction of the grate, charged with combustion air; by the fact that the waste materials are ignited in the charging area of the grate with superstoichiometric introduction of oxygen; and that in the direction of the slag removal the combustion is limited to a substoichiometric level, which is required for gasification of the combustible components as well as for a device with the characteristics in Claim 12.

In this process the energy needed for gasification is not introduced from outside through excessively vigorous combustion at the end of the firing grate, and hence through heating of the combustion air and through radiant energy from the roof area which has been heated up by this incineration; instead this gasification energy comes from the incineration of the waste materials, which are continuously ignited in the charging area of the grate under superstoichiometric conditions and then continue to be incinerated under substoichiometric conditions. As a result there is always an adequate supply of energy available, making possible a stable combustion process which leads to good ash burnout and to avoidance of pyrolysis coke in the left-over residue. Since the necessary energy comes from the fuel as a result of its ignition, and does not need to be transferred to the waste materials from outside, this yields a greater degree of efficiency, with the result that it is no longer necessary to burn so much of the waste material to generate energy for the gasification process, so that a larger quantity of usable gas can be created.

These beneficial effects are still further enhanced, under a refinement of the invention, by adding oxygen to the gasification air at a substoichiometric level after the waste materials are ignited.

The advantage of this measure is that the quantity of gasification air, and hence the quantity of nitrogen which functions as ballast, can be reduced very significantly, which leads to a number of benefits. One of the benefits is that as a result of the smaller quantity of gasification air the flow speed through the bed of the fuel mass is lowered, which leads to a noticeable reduction in the flow of airborne dust. An additional substantial advantage is that lowering the proportion of nitrogen reduces the formation of nitrogen oxides. There continues to be a relatively large measure of energy available for the gasification, since it is no longer necessary to heat up so much nitrogen, which is present in the gasification air only as ballast.

The gasification is preferably carried out in such a way that the gasification temperature of the substances to be gasified is 600 to 850°C, and the air ratio needed to achieve substoichiometric gasification is 0.4 to 0.8.

The gases which are produced can be used in a great variety of ways. Preferably, provision is made to use the created gases by burning exclusively the combustible components which come from the first furnace in a second furnace which is connected to the first either directly or by a gas extraction system. This procedure depends primarily upon the oxygen content and the calorific value of the gases coming from the first furnace.

If the oxygen content of the waste gases coming from the first furnace is not sufficiently high, in order to achieve complete combustion it is beneficial to add combustion air in the form of ambient air to the waste gas coming from the first furnace.

On the other hand, if the calorific value of these gases is not sufficient to enable the necessary incineration at a higher temperature, then in a refinement of the invention a higher-grade combustible gas can be added to the combustible components in the second furnace, in accordance with their calorific value, along with the combustion air.

To achieve higher combustion temperatures in the second furnace than is possible with ambient air, there is benefit in mixing oxygen with the combustion air for the second furnace and/or to the higher-grade combustible gas, in a refinement of the invention. The introduction of oxygen in addition to the combustion air has the advantage that the quantity of combustion air which needs to be added can be kept down, which allows the quantity of waste gas from the second furnace to be reduced.

If there is sufficient oxygen present in the waste gas coming from the second furnace, and if the calorific value is also sufficiently high, waste gas which is taken from the waste gas stream after cooling in a waste heat recovery system can be introduced for mixing and burning the gases in order to regulate the combustion in the second furnace. This procedure has the advantage that any gases which may still be combustible when they leave the second furnace are burned in addition; and furthermore the quantity of waste gas is lower compared to the procedure in which a higher-grade combustible gas is added.

The incineration in the second furnace is carried out by selecting from the measures described above, preferably in such a way that in the second furnace the air ratio is 1.1 to 1.8. The combustion temperature of the gases in the second furnace is 950 to 1250°C.

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The device for carrying out the process is characterized by the fact that in a furnace which comprises a fuel charging system, a grate with undergrate forced draft chambers subdivided in the longitudinal direction and possibly also in the transverse direction, and a slag removal system, the forced draft chambers have lines for the introduction of oxygen. This makes it possible to regulate the gasification with a fine touch, and furthermore with smaller quantities of waste gas compared to the exclusive use of ambient air for the gasification process.

If utilization of the generated gases by burning is planned, then the invention provides for connection of a second furnace with the first furnace, either directly or through a waste gas flue. This prevents any significant cooling of the combustible gases which arise in the first furnace, and consequently the combustion in the second furnace can be carried out at a relatively low excess air ratio, in many cases even without additional sources of energy, at such high temperatures that all of the organic components in the combustible gas can be broken down without promoting the formation of nitrogen oxides, since the temperature in the second furnace is kept at a level which is lower than a critical temperature limit at which greater quantities of nitrogen oxides begin to be formed.

In order to be able to carry out the advantageous refinements of the process, advanced implementations of the device provide for the second furnace to be equipped with at least one line for the introduction of combustion air, at least one line for the introduction of a higher-grade combustible gas, or at least one line for the introduction of recirculated waste gas. These three measures can optionally be provided individually or in combination, depending upon the type of implementation.

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The invention is explained in additional detail below on the basis of a sample implementation shown in the drawing, the only figure of which is a schematic representation of a furnace with a second furnace connected to it.

As can be seen from the drawing, the device for carrying out the process comprises in its essentials a furnace which is identified in its entirety as 1, as used heretofore for waste incineration, in combination with a second furnace 2 functioning as an afterburner chamber, followed by a heat exchanger 3. The other requisite devices, especially for cleaning the waste gases, are not shown in this drawing, since they are part of the current technology of furnaces and are superfluous to an explanation of the invention.

The first furnace 1 comprises a charging funnel 4 with adjacent charging chute 5, by means of which the waste materials which are to be burned are conveyed to a firing grate 6; the waste materials on the firing grate 6 are designated as 7. Beneath the firing grate 6 there are individual forced draft chambers 8a to 8e, through which air is introduced from a supply line 9 through lines 9a to 9e. The air passes through the grate 6 into the combustion chamber 10. Through the forced draft chambers 8a and 8b combustion air is supplied, possibly mixed with oxygen, in order to ignite the waste materials in a superstoichiometric atmosphere. After this initial phase of ignition air is conveyed to the grate through the forced draft chambers 8c to 8e as gasification air, preferably mixed with oxygen, with the quantity of gasification air and the quantity of oxygen adjusted so that the gasification takes place substoichiometrically with an air ratio of $\lambda = 0.4$ to 0.8. Oxygen is conveyed to the individual forced draft chambers through the lines 11a to 11e,

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In the second furnace 2 the excess air ratio is adjusted to between 1.1 and 1.8, preferably at 1.2, by introducing combustion air through a line 14. The resulting temperatures are in the range of 950 to 1250°C. If the gas to be burned, coming from the first furnace 1, has too low a calorific value, an additional line 15 is provided for the introduction of high-grade combustible gas, such as natural gas. Both the line 14 for combustion air and the line 15 for higher-grade gas can have lines 16 and 17 connecting to them for additional oxygen. An additional line 18 can be provided in order to introduce recirculated waste gas into the second furnace 2; this recirculated waste gas is cooled to a temperature below 300°C after having passed through the heat exchanger 3. This recirculated waste gas is thoroughly mixed with the combustible gas in the second furnace 2, avoiding the introduction of too much combustion air, which would be needed to create turbulence and which would increase the quantity of waste gas and also the temperature which occurs in the second furnace. At the same time any combustible components which are still

present in this waste gas can be burned. The gases coming from the heat exchanger 3 are conducted through a line 19 to an exhaust gas cleaning system, which is not shown because it is not part of the invention and is generally known.

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Patent claims

1. Process for creating and utilizing gas from waste materials, in which the waste materials are conveyed along a grate in a furnace and combustion air is applied, **characterized by the fact** that undergrate forced draft chambers at least in the longitudinal direction of the grate have combustion air applied to them in such a way that the waste materials in the charging area of the grate are ignited while oxygen is supplied at a superstoichiometric level, and by the fact that in the direction of slag removal the combustion is limited to a substoichiometric level, which is necessary for gasification of the combustible components.
2. Process as in Claim 1, **characterized by the fact** that after ignition of the waste materials oxygen at a substoichiometric level is mixed into the gasification air.
3. Process as in Claim 1 or 2, **characterized by the fact** that the gasification temperature of the waste materials to be gasified is 600 to 850°C.
4. Process as in one of the claims 1 to 3, **characterized by the fact** that the air ratio to achieve substoichiometric gasification is 0.4 to 0.8.

5. Process as in one of the claims 1 to 4, **characterized by the fact** that in utilizing the resulting gases in a second furnace, which is connected to the first furnace either directly or via an exhaust gas flue, exclusively the combustible components which come from the first furnace are burned.
6. Process as in one of the claims 1 to 5, **characterized by the fact** that combustion air in the form of ambient air is added to the exhaust gas coming from the first furnace.
7. Process as in one of the claims 1 to 6, **characterized by the fact** that in the second furnace a higher-grade combustible gas is added to the volatile components in accordance with the calorific value of the latter.
8. Process as in claim 7, **characterized by the fact** that oxygen is mixed into the combustion air for the second furnace and/or into the higher-grade combustible gas.
9. Process as in one of the claims 1 to 8, **characterized by the fact** that in the second furnace recirculated exhaust gas which is removed from the exhaust gas stream after cooling down in a heat recovery system is introduced to mix and burn out the gases.
10. Process as in claims 5 to 9, **characterized by the fact** that the air ratio in the second furnace is 1.1 to 1.8.
11. Process as in one of the claims 5 to 10, **characterized by the fact** that the combustion temperature in the second furnace is 950 to 1250°C.

12. Device for carrying out the process according to one of the claims 1 to 11, **characterized by the fact** that in the case of a furnace (1) comprising a fuel charging system (4, 5), a grate (6) with undergrate forced draft chambers which are subdivided in the longitudinal and possibly also in the transverse direction (8a to 8e), and a slag removal system (13), the undergrate forced draft chambers (8a to 8e) have lines (11a to 11e) for introducing oxygen.

13. Device as in claim 12, **characterized by the fact** that a second furnace (2) is connected with the first furnace (1) either directly or through an exhaust gas flue (12).

14. Device as in claim 12 or 13, **characterized by the fact** that the second furnace (2) has at least one line (14) for supplying combustion air.

15. Device as in one of the claims 12 to 14, **characterized by the fact** that the second furnace (2) has at least one line (15) for introducing a higher-grade combustible gas.

16. Device as in claim 14, **characterized by the fact** that a line (16) for introducing oxygen is connected into the line (14) for the combustion air.

17. Device as in Claim 15, **characterized by the fact** that a line (17) for introducing oxygen is connected into the line (15) for a higher-grade combustible gas.

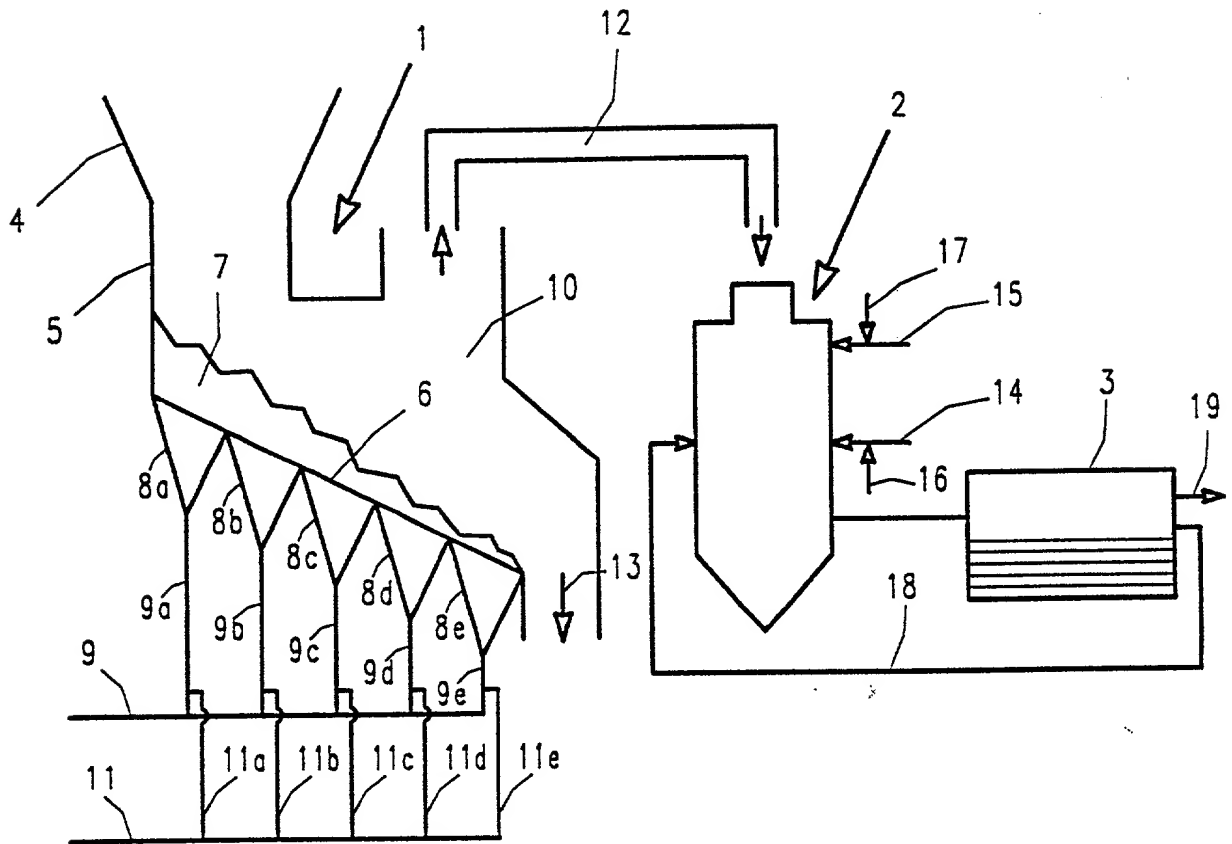
18. Device as in one of the claims 12 to 17, **characterized by the fact** that the second furnace (2) has at least one line (18) for introducing recirculated waste gas.

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SUMMARY

In this process for gasifying and burning waste materials, the waste materials are introduced into an incinerator (1) and end up on a burning grate (6) to which air is conducted by means of various undergrate forced draft chambers (8a to 8e). In the first area air is introduced at a superstoichiometric level in order to ignite the waste materials. Then, via the undergrate forced draft chambers (8c to 8e), oxygen is mixed into the air which is used for the gasification, at the same time establishing a substoichiometric level which leads to gasification of the waste materials. These combustible gases which come about in the process pass via the waste gas flue (12) into a second furnace (2), in which the gases are burned at a superstoichiometric level through the introduction of combustion air. The resulting waste gases pass to a heat exchanger (3).

(Figure)



Express Mail No. EM448813693US

Attorney Docket No. ZMYJ-05-116

DECLARATION, POWER OF ATTORNEY, AND PETITION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

the specification of which (check one below):

☒ (XX) is attached hereto.

☐ () was filed on _____ as Application Serial No. _____ or Express Mail No. _____, Serial No. not yet known, and was amended on _____ (if applicable).

☐ () was filed on _____ as PCT International Application No. _____, and as amended under PCT Article 19 on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

<u>196 50 119.9</u> (Number)	<u>Germany</u> (Country)	<u>December 3, 1996</u> Day/Month/Year Filed	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<u> </u> (Number)	<u> </u> (Country)	<u> </u> Day/Month/Year Filed	<input type="checkbox"/> Yes <input type="checkbox"/> No
<u> </u> (Number)	<u> </u> (Country)	<u> </u> Day/Month/Year Filed	<input type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under Title 35, United States Code, §120 and/or §119(e) of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations §1.56, which became available between the filing date of the prior application and the national or PCT international filing date of this application.

<u> </u> (Serial No.)	<u> </u> (Filing Date)	<u> </u> (Status: Patented, Pending, or Abandoned)
<u> </u> (Serial No.)	<u> </u> (Filing Date)	<u> </u> (Status: Patented, Pending, or Abandoned)
<u> </u> (Serial No.)	<u> </u> (Filing Date)	<u> </u> (Status: Patented, Pending, or Abandoned)

I hereby appoint Richard H. Evans (R. No. 19,755), John D. Poffenberger (R. No. 20,245), Bruce Tittel (R. No. 22,324), Donald F. Frei (R. No. 21,190), David J. Josephic (R. No. 22,849), A. Ralph Navaro, Jr. (R. No. 23,050), David S. Stallard (R. No. 25,930), J. Robert Chambers (R. No. 25,448), Gregory J. Lunn (R. No. 29,945), Kurt L. Grossman (R. No. 29,799), Clement H. Luken, Jr. (R. No. 32,742), Thomas J. Burger (R. No. 32,662), Gregory F. Ahrens (R. No. 32,957), Joseph R. Jordan (R. No. 25,686), Wayne L. Jacobs (R. No. 35,553), Kurt A. Summe (R. No. 36,023), C. Richard Eby (R. No. 25,854), Thomas W. Humphrey (R. No. 34,353), Keith R. Haupt (R. No. 37,638), David E. Pritchard (R. No. 38,273), Theodore R. Remaklus (R. No. 38,754), J. Dwight Poffenberger, Jr. (R. No. 35,324), and Stephen W. Barns (R. No. 38,037) my attorneys, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Address all correspondence and telephone calls to Thomas J. Burger at Wood, Herron & Evans, P.L.L., 2700 Carew Tower, Cincinnati, Ohio, 45202 at telephone number (513) 241-2324.

Wherefore I pray that Letters Patent be granted to me for the invention or discovery described and claimed in the foregoing specification and claims, and I hereby subscribe my name to the foregoing specification and claims, declaration, power of attorney, and this petition.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor
(given name, family name) Johannes Martin

Inventor's signature Johannes Martin Date 6.10.97

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Second inventor's signature [Signature] Date 06.10.97

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Germany

Full name of third joint inventor,
if any (given name, family name) _____

Third inventor's signature _____ Date _____

City and State of Residence _____ Citizenship _____
Post Office Address _____

Full name of fourth joint inventor,
if any (given name, family name)_____

Fourth inventor's signature_____Date_____

City and State of Residence_____Citizenship_____

Post Office Address_____

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